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COMPLETE SPECIFICATION.

Photographic Camera and Lighting Assembly.

We, THE GENERAL ELECTRIC COMPANY LIMITED, a British Company, of Magnet House, Kingsway, London, W.C.2, ALEXANDER ALBERT CHUBB, of Greenroyd, Henley Drive, Rawdon, Yorkshire, and DOUGLAS STANLEY ELLIOTT, of The General Electric Company Limited, Telephone Works, Coventry, both British Subjects, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to camera and lighting assemblies for illuminating and photographing an object field. It should be understood that for the purposes of the present Specification an object field is substantially a plane and is the position relative to a camera and lighting assembly occupied by a field of objects, such as the faces of electric meters, to be photographed.

A particular application of the present invention lies in photographing the meters of subscribers on a telephone exchange. Such meters are generally mounted in groups on racks, the faces of the meters on a rack lying substantially in the same plane. The spacing between adjacent racks is naturally kept to a minimum. It is therefore necessary to provide a camera and lighting assembly which can readily be located with accuracy relative to the faces of the meters, and which will provide uniform lighting over the area of the meter faces to be photographed, the camera and lighting assembly being necessarily of a restricted size and weight so as to permit adjustment and location under control of a single operator within the space available.

The design of an assembly of the type described is complicated in that each meter usually contains four number wheels, one character on each of which is visible through a slot in the meter cover. The face of each number wheel is at a position slightly behind the plane of the cover front, so that light must be made to enter the meter in such a manner as to reach down somewhat below the surface of the cover. In addition, light must impinge on the meter in such a fashion that no specular reflection reaches the camera from the transparent surface of a glass or transparent plastic sheet inserted in the meter cover to protect the number wheels.

It is an object of the invention to provide camera and lighting assemblies operable to provide a substantially uniform illumination on an object field to be photographed.

According to the present invention, a camera and lighting assembly comprises a box or case of opaque material at one end, a camera at the other end for photographing a field of objects placed, during operation, at the said open end, two artificial light sources or two groups of artificial light sources, a plurality of mirrors and a plurality of screens, the said light sources, the mirrors and the screens being housed within the box or case so that no part of the said open end is obscured from the camera lens, and the arrangement of the said light sources, the mirrors and the screens within the box or case being such that, during operation, light from the said light sources is directed onto the object field so that the whole field is illuminated substantially uniformly and separate parts of the said field are respectively illuminated directly and/or indirectly only by different ones of the said two light sources or the said two groups of light sources, the said parts together constituting substantially all of the said object field.

Two camera and lighting assemblies in accordance with the present invention will now be described, by way of example, with

reference to the accompanying diagrammatical drawings in which:—

Figure 1 is a plan view of a first assembly according to the invention;

Figure 2 is a plan view of a second assembly according to the invention; and

Figure 3 is a view of the assembly illustrated in Figure 2 as seen from the object field.

The invention will be described in its application to the photography of subscribers' meters at a telephone exchange.

The arrangement illustrated in Figure 1 comprises a box or case 2, four electric filament lamps, of which only the lamps 4 and 5 are visible, screens 6, 7, 10 and 11, mirrors 8 and 9 and a camera 3. The end of the box or case 2 opposite the camera 3 is provided with an aperture which defines the object field 1 to be photographed. The object field 1 in the present instance is assumed to include a group of subscribers' meters (not shown) of known form, the group consisting of a hundred meters say arranged in a rectangle, each side accommodating ten meters. The box or case 2 is of a substantially rectangular form and is constructed of light-opaque material, the whole of the inside surface of the box or case 2 being blackened to prevent reflection.

Each meter consists of wheels which have characters on their faces and which are located behind a rectangle of transparent material such as glass. It is therefore essential to ensure for photographic purposes not only that each character is illuminated substantially equally throughout the whole of the object field 1 but also that no specular reflection shall be visible from the position of the camera 3. To this end, each half of the object field is illuminated from a lamp or lamps situated on the opposite side of the assembly. Thus the meters on the left hand side of the field 1 are illuminated by the lamp 4, and the meters on the right hand side of the field 1 are illuminated by the lamp 5. This ensures that any specular reflection from the meter covers falls only or mainly on the sides of the box or case 2 and therefore does not reach the lens 14 of the camera 3. Since the object field 1 to be photographed is not only rectangular but approximately square, each of the lamps 4, 5 is duplicated, another lamp being located immediately beneath each of the lamps 4 and 5 shown. The situation of the lamps relative to the object field 1 and each other is such as to give reasonably uniform illumination over the plane of the object field 1. The light from lamp 5 is prevented from falling on the left hand side of the field 1 by screen 6 and the light from the lamp 4 is prevented from falling on the right hand side of the field 1 by screen 7.

In practice, it is found that using illumination of the type described provides too high a degree of illumination at the centre of the field 1 and too low an illumination at the edges of the field 1. A further disadvantage encountered is that since the meter characters are situated at a short distance behind the front of the meters, the characters on the edges of the field 1 tend to be shadowed and thus not easily photographed. To reduce both of these effects mirrors 8 and 9 are located on either side of the object field 1, the mirrors 8 and 9 extending from top to bottom of the field 1. Each mirror 8 and 9 is illuminated by the lamps situated on the opposite side of the assembly as shown, with the result that light enters the transparent apertures of the meters from two directions instead of one, the light from one direction being from the real source such as the lamps 4 or 5, and the light from the other direction being from a virtual source, seen in mirror 8 or 9. Since the two sources of illumination are on opposite sides of each meter, no character remains unilluminated, and the degree of illumination throughout the field 1 is made more uniform. The beam of light from the lamp 4 is further limited by screen 10 and the beam of light from the lamp 5 by screen 11, so that the extreme edges of each beam of light converge as shown on the optical axis of the field 1 after reflection in mirrors 8 and 9.

In order to ensure not only that specular reflection onto the camera 3 does not take place, but also that the various light beams terminate at the appropriate places, it is preferable to employ point sources of illumination. As, however, these are not normally available commercially, lamps having clear glass bulbs and C-shaped filaments are employed. The said lamps are located so that the plane of each filament lies in the plane 12 or the plane 13, these planes touching the edges of the screens 6 and 7. Since the edges of these screens 6 and 7 are vertical, the masking effect of the screens is sharp enough for all practical purposes. By the means outlined, it is found possible to secure a degree of illumination over the whole field 1 which does not vary by more than + or −20% from a mean value. This is quite good enough to enable photographic prints to be made showing all the characters on all meters.

The camera 3 is fitted so that its lens 14 butts against an aperture in the rear face of the box or case 2. The camera 3 is preferably detachably mounted and is arranged to contain sufficient film to facilitate the photography of a large number of groups of meters in an exchange although this is of course not essential. Again, the camera 3 is preferably located so that a field slightly greater than that occupied by the faces of a hundred meters is included on the negative, the portion of the extra surface so covered being

devoted to a time and date strip inserted in the assembly at a point close to the object field 1 before photographic operations commence. Thus, each picture of a hundred meters contains not only information concerning the meter readings, but also of the date and time when the photograph was taken.

The assembly may be provided, if required, with a control circuit. This circuit supplies the lamps 4, 5 and the like with current at approximately half full value, this current being automatically increased for a short time to full value during exposure periods. The circuit also includes a contact provided in the camera, and means for operating a solenoid in the camera, the cycle of operations effected by the control circuit being to apply full voltage to the lamps, wait until the lamps have reached full brilliancy (say 0.2 seconds) operate the camera shutter, move on the film one section, and reduce the lamp current. This cycle is initiated by the pressure of a button by an attendant who also locates the assembly opposite the group of meters to be photographed.

An alternative form of the invention is shown in Figures 2 and 3. Here the object field 20 is illuminated by two lamps 22 and 31 only, one lamp 22 being situated above and one lamp 31 below the camera. Thus only two lamps are required as compared with the previous design employing four. The light beam from each lamp 22 and 31 is emitted sideways to both left and right, and is there reflected by mirrors 23, 24, in the direction of that half of the object field 20 which is opposite from the mirrors. By this means two virtual sources 25 and 26 are created, corresponding to the lamps 5, 4 in Figure 1. The side mirrors 27, 28 are again provided, the beam from each lamp being wide enough to include not only half of the object field 20 but also the face of the adjacent mirror 27 or 28. The screens 29, 30, 31 and 32 limit the emission of light from each lamp 22 and 31 both in the direction of the object field 20 and from the camera lens which is situated at the point 35. Each lamp is so screened as to illuminate both halves of the object field 20.

Figure 3 shows the assembly illustrated in Figure 2, from the position of the object field 20, the meters being of course absent. The camera lens is located at the point 35, the lens butting against a hole in the rear wall of the assembly. The lamp 22 is partly enclosed by the screens 29 and 30, and the lamp 31 is partly enclosed by screens 32, 33. The mirrors 23 and 24 create four virtual images seen from the appropriate points on the object field 20, and the mirrors 27, 28 create further virtual images illuminating the field 20 from directions opposite from those derived from the mirrors 23, 24. The whole of the interior surface of the assembly other than that of the mirror faces is blackened to ensure that no specular or other reflections reach the camera.

The edge 34 of the assembly may, if necessary, be provided with a resilient lightproof material, such as felt or sponge rubber, and the assembly may be mounted in such a way that during photographic operations the edge 34 may be pressed against the support on which the meters are mounted. This acts to eliminate unwanted illumination from the meter faces and may also stabilize the position of the assembly relative to the meters.

To ensure that light falls on the meter surfaces at only such angles as to prevent reflection into the camera lens 14 and to prevent substantial overlapping of illuminated areas, it is essential that the filaments of the lamps 22, 31 shall be either point or line sources. To this end, lamps of the type used on motor vehicles are employed each lamp having a centrally located filament shaped like a spiral spring, the axial length of the spiral being large compared with its diameter. The lamps are mounted with the axes of the filament spirals co-linear and coincident with the plane 21 which contains the optical axis of the camera (not shown).

From the foregoing it will be seen that a lamp and camera assembly has been provided which not only ensures adequate and substantially uniform illumination of a field of objects which it is required to photograph, but also supports the camera in such a position that no unwanted reflections from the surfaces of the said objects are liable to interfere with the photographic operation. The said assembly is preferably made light so as to be easily transportable, and may be provided with handles to assist in such transport.

What we claim is:—

1. A camera and lighting assembly comprising a box or case of opaque material open at one end, a camera at the other end for photographing a field of objects placed, during operation, at the said open end, two artificial light sources or two groups of artificial light sources, a plurality of mirrors and a plurality of screens, the said light sources, the mirrors and the screens being housed within the box or case so that no part of the said open end is obscured from the camera lens, and the arrangement of the said light sources, the mirrors and the screens within the box or case being such that, during operation, light from the said light sources is directed onto the object field so that the whole field is illuminated substantially uniformly and separate parts of the said field are respectively illuminated directly and/or indirectly only by different ones of the said two light sources or the said two

groups of light sources, the said parts together constituting substantially all of the said object field.

2. A camera and lighting assembly according to Claim 1 in which, all of the interior surface of the said box or case, excluding the mirrors and the said light sources, are blackened to prevent specular reflection therefrom.

3. A camera and lighting assembly according to Claim 1 or Claim 2 in which the said light sources, the mirrors and the screens are symmetrically disposed relative to a plane which contains the optical axis of the camera.

4. A camera and lighting assembly according to Claim 3 in which two groups each comprising at least two light sources are provided one group on each side of the said plane which contains the optical axis of the camera, the arrangement being such that, during operation, the said light sources of the group on one side of the said plane illuminate that part of the object field which is on the opposite side of the said plane.

5. A camera and lighting assembly according to Claim 4 in which, during operation, that part of the object field which is on one side of the said plane is illuminated both directly and indirectly by the said light sources on the opposite side of the said plane.

6. A camera and lighting assembly according to any one of the preceding claims in which the said light sources are electric filament lamps.

7. A camera and lighting assembly according to Claim 3 in which two light sources are provided each comprising an electric filament lamp, the said two lamps having their filaments substantially in the said plane which contains the optical axis of the camera and the arrangement being such that, during operation, each lamp illuminates a different part of the object field on both sides of the said plane.

8. A camera and lighting assembly according to Claim 7 in which, during operation, the said object field is illuminated indirectly by the said lamps.

9. A camera and lighting assembly according to Claim 7 or Claim 8 in which, the filament of each lamp is of cylindrical form, the length of the cylinder being much greater than its diameter, the said lamps being mounted so that the axes of their filaments are co-linear and coincident with the said plane which contains the optical axis of the camera.

10. A camera and lighting assembly according to any one of Claims 6 to 9 having an electric control circuit operable to control the supply of current to the said lamps and to operate the camera in accordance with the predetermined cycle.

11. A camera and lighting assembly substantially as hereinbefore described with reference either to Figure 1 or to Figures 2 and 3 of the accompanying diagrammatical drawings.

For the Applicants,
W. J. C. CHAPPLE,
Chartered Patent Agent.

PROVISIONAL SPECIFICATION.

Photographic Camera and Lighting Assembly.

We, THE GENERAL ELECTRIC COMPANY LIMITED, a British Company, of Magnet House, Kingsway, London, W.C.2, ALEXANDER ALBERT CHUBB, of Greenroyd, Henley Drive, Rawdon, Yorkshire, and DOUGLAS STANLEY ELLIOTT, of The General Electric Company Limited, Telephone Works, Coventry, both British Subjects, do hereby declare this invention to be described in the following statement:—

Our invention relates to means for photographing a collection of articles located substantially in a single plane, such as the faces of electric meters, and has for its object the provision of a lighting and camera assembly adapted to provide a substantially uniform illumination on the surface to be photographed, to hold the camera in a suitable position, and to form a single unitary assembly of as small a size as possible.

The invention is more particularly concerned with the provision of a lighting and camera assembly for the purpose of photographing the meters of subscribers on a telephone exchange. Such meters are generally mounted in groups on racks, and the spacing between adjacent racks is naturally kept to a minimum. It is therefore necessary to provide a lighting and camera assembly which can readily be located with accuracy relative to the faces of the meters, and which will provide uniform lighting over the area of the meter faces to be photographed, the lighting and camera arrangements being necessarily of a restricted size and weight so as to permit adjustment and location under control of a single operator within the space available.

The design of a device of the type described is complicated in that each meter usually contains four number wheels, one figure on each of which is visible through a slot in the meter cover. The face of each number wheel is at a position slightly behind

the plane of the cover front, so that light must be made to enter the meter in such a manner as to reach down somewhat below the surface of the cover. In addition, light must impinge on the meter in such a fashion that no specular reflection reaches the camera from the transparent surface of a glass or transparent plastic sheet inserted in the meter cover to protect the number wheels.

To this end, we provide a box of substantially rectangular form, one end of which is adapted to be pressed or placed against the faces of the meters on the rack. The end of the box nearest the meters is provided with an aperture just sufficient to include the total number of meter faces to be photographed at one time, e.g. 100 meters located in ten rows with 10 meters in each row. The camera required for photographing the meters is placed at the other end of the box with its lens pointing in the direction of the meters and at such a distance as to include the whole of the 100 meters, together with a date or identification label. Two lamps are now placed on each side of the camera, the said lamps having plain glass bulbs, and filaments extending in one plane. The lamps on each side are disposed so that the plane of their filaments passes substantially through the centre line of the group of meters, and each pair of lamps is screened so as to prevent their light from reaching the meters on the side of the centre line corresponding to the said lamps. This ensures that specular reflection from the meter cover glasses takes place only towards the side of the camera box assembly and not towards the camera.

This lighting, however, suffers from the disadvantage that the meters furthest from the lamps receive appreciably less light than those near the centre of the field, and also in that light passing at an angle through the cover slots of the meters nearest the edge of the field tends to miss at least part of one of the figures on the meter. We overcome both these difficulties by providing plane mirrors located on the sides of the camera assembly nearest the meters furthest from their associated lamps, and illuminating the said mirrors from the said lamps.

Thus new virtual sources of illumination are provided at the rear of the mirror, this second illumination also causing no specular reflection into the lens but in addition penetrating to the meter figures not previously illuminated. The arrangement is made symmetrical about a centre plane, so that the two lamps on the left side of the carrier assembly illuminate the meters and mirror on the right and vice versa.

In an alternative form of our invention, a box of the form previously described is provided, as before, to exclude daylight and to carry the camera and lamps, except that this time only two lamps are provided, one above and one below the camera. The lamp filaments are screened completely from the camera lens and from the meter faces, but light from each lamp filament is emitted towards each side of the box, where it encounters a plane mirror tilted so as to direct the light from the left side of the lamp towards the meters on the right hand side of the field, and from the right hand side of the lamps towards the meters on the left hand side of the field. Light from these mirrors also illuminates two further mirrors, each located as previously described, i.e. one on each side of the meter field. Thus each meter is again illuminated by light from two sources this time both being virtual.

According therefore to our invention a lamp and camera assembly adapted to illuminate a plane field of articles to be photographed comprises a box or case in which lamps and camera are mounted, at least two lamps arranged to illuminate the field in two separate halves, and plane mirrors so located relative to the light sources that each article to be photographed is illuminated from at least two separate light sources, at least one of which is virtual.

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771,805 COMPLETE SPECIFICATION
3 SHEETS

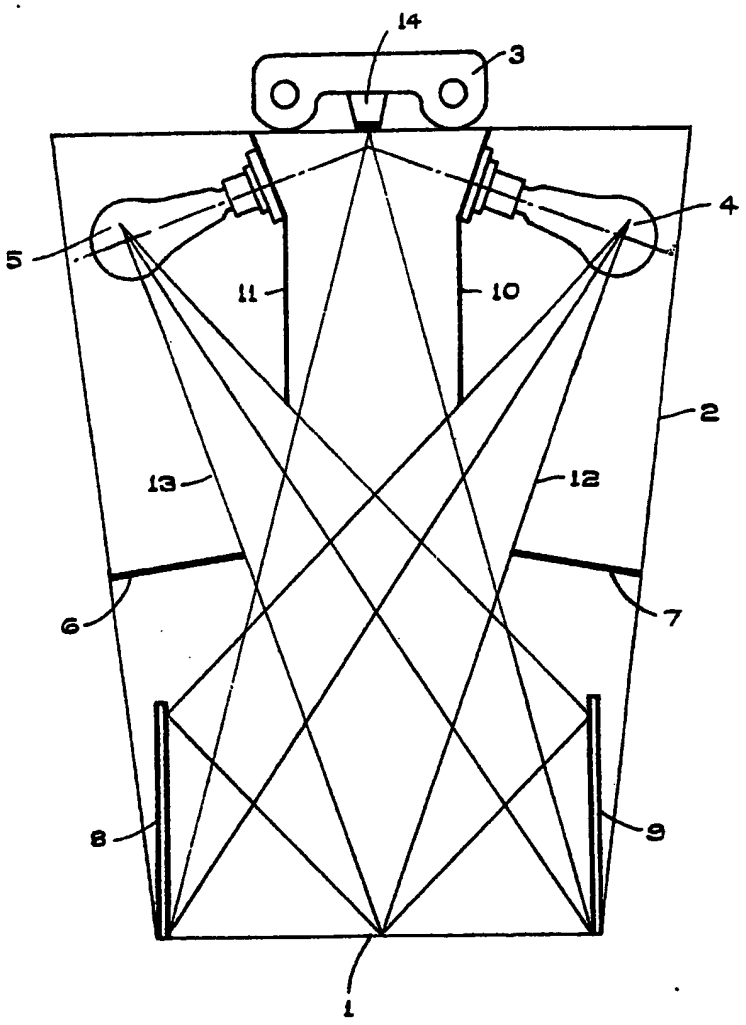

FIG. 1

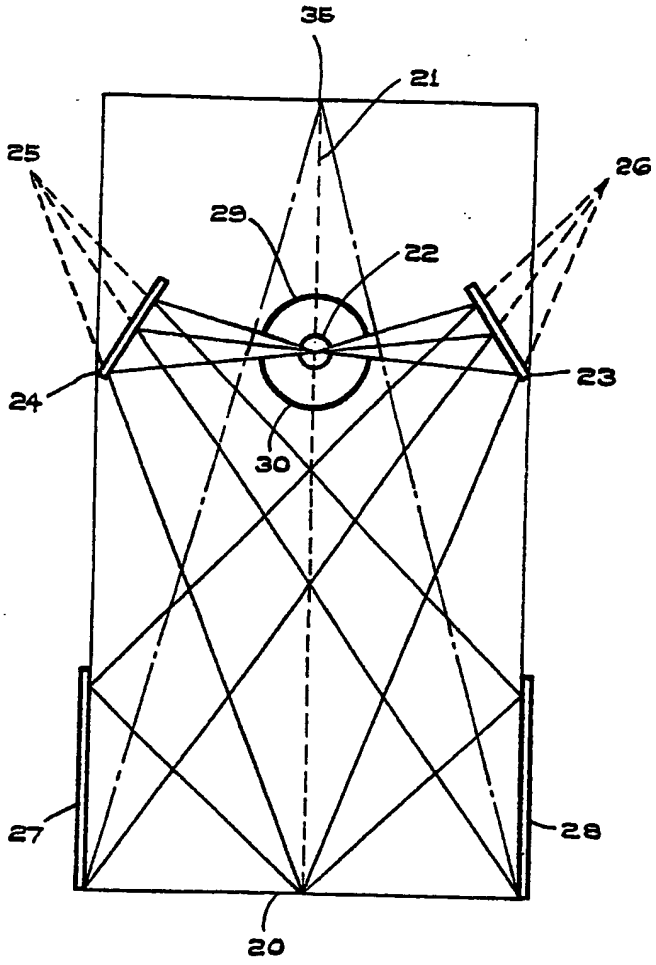

FIG. 2

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SHEETS 2 & 3

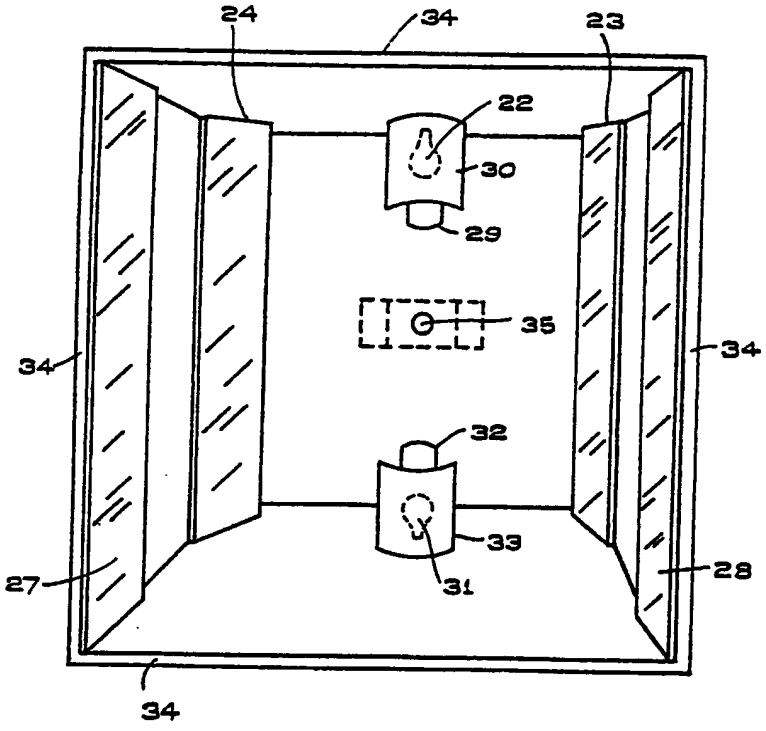

FIG. 3.

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SHEETS 2 & 3

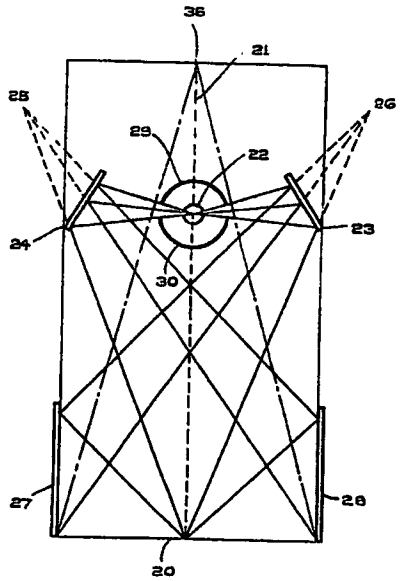

FIG. 2

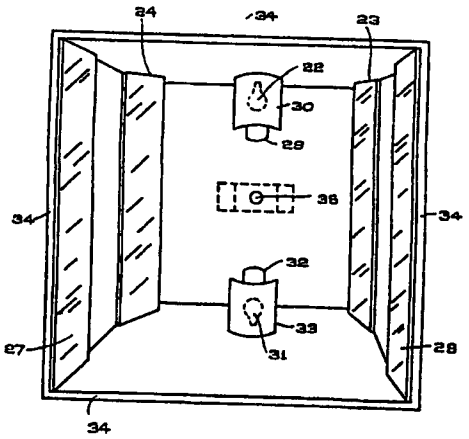

FIG. 3.

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